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EP-A- 0 133 598
FR-A- 2 445 967
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US-A- 3 613 075
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US-A- 3 707 701
US-A- 4 355 298

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Description

This invention relates to a method of detecting a deflated tyre on a vehicle and provides a system suitable for cars and truck or the like.

Hitherto deflation warning devices have measured a property of the tyre for example the internal pressure or temperature and then transmitted a signal to the vehicle body. The transmission may be by means of a electrical signal through slip rings at the hub or by radio transmission. Such transmission systems are expensive and notoriously unreliable particularly in the hostile environment of a vehicle wheel and bearing in mind the infrequency of tyre failures.

Theoretically a tyre and especially a tyre with a breaker has a constant, fixed circumference tread which travels on each wheel at the same speed with respect to the vehicle frame of reference as the vehicle speed on the road. The fixed length circumference means that each wheel rotates at the same angular velocity regardless of its deflation in the ground contact zone. However, the inventors have found that a radial tyre does rotate with an increased angular velocity when it is deflated. For example it is found that in the case of a 13" car radial tyre of the steel reinforced breaker type, a pressure loss of 1.2 bar increases the rotational speed by 0.27 %, and it is on this discovery that the present invention is based.

Prior art document FR-A- 2 568 519 discloses a method of detecting a partially deflated pneumatic tyre on a vehicle having four tyres each mounted on a wheel by sensing the angular velocity of each wheel and producing a signal proportional thereto and processing the four signals in a processor unit which subtracts the sum of the signals from one pair of diagonally opposite wheels from the sum of the signals from the other pair of diagonally opposite wheels.

It is a major object of the invention to provide a method of detecting a partially deflated tyre which does not suffer from the transmission problems of prior art systems and which provides the system at minimum costs and maximum reliability fully commensurate with the modern vehicle and which in many cases can take full advantage of some of the electronic equipment already fitted to the vehicle.

Accordingly the invention provides a method of detecting a partially deflated pneumatic tyre on a vehicle having four tyres each mounted on a wheel by sensing the angular velocity of each wheel and producing a signal proportional thereto and processing the four signals in a processor unit which subtracts the sum of the signals from one pair of diagonally opposite wheels from the sum of the signals from the other pair of diagonally opposite wheels, sensing when the magnitude of the result is between 0.05% and 0.60% of the mean of the two sums of the signals from the two pairs of diagonally opposite wheels, the method further comprises the steps of comparing the signals for each of the four wheels in turn with the signals for each of the other wheels, sensing when one of said signals is different to the average of all four signals by more than 0.1% and in the event of both sensed signal factors being present operating a warning device to indicate a tyre is partially or completely deflated.

More preferably the magnitude of the result is sensed in the range of 0.10% and 0.30%.

The processing unit preferably repeats the two sensing operations and operates the warning device when at least two successive results each give an indication of a deflated tyre, but ignores results which are not followed by a similar result so that spurious signals are avoided.

Preferably the processing unit also monitors the lateral acceleration of the vehicle either by taking a signal from an acceleration sensing unit or by calculating the lateral acceleration by comparing the angular wheel velocity signals from each of the sides of the vehicle at both the front and rear pair of wheels. The processing unit determines when the vehicle lateral acceleration may cause a false indication and inhibits the warning signal. This depends on the lateral acceleration and the time for which it is in existence. In one preferred situation a figure of more than 0.03 g average over a six second period is the critical case but this is dependent on vehicle load transfer conditions and the particular tyres fitted.

The processing unit preferably also monitors the vehicle acceleration and deceleration and inhibits the signals for accelerations which may cause a false signal. In a preferred case this is to inhibit the signal if a figure of 0.03 g averaged over a period of more than six seconds but again this depends on load transfer and tyre characteristics for the vehicle concerned.

In both these cases of acceleration sensed inhibition it is important to note the time factor. In use of a vehicle accelerations as low as 0.03 g are only very rarely exceeded for the six second time specified and the system is then fully active for more than 95% of driving time.

To allow for increasing vehicle speed it is usually necessary to increase the sensitivity of the unit as the speed increases. This may be a continuous increase or a stepwise increase. The processing unit may also be inhibited when the vehicle brakes are applied.

The angular speed of the wheels of the vehicle may be measured either by a digital pulse generator associated with each wheel or by means of timing the rotation of each wheel.

An important advantage of this method of sensing a deflation in a vehicle tyre is that it may utilise the electronic equipment and signal generating units already fitted to a vehicle for an electronically controlled anti-skid system. Such systems monitor vehicle speeds and by sensing deceleration of the wheels avoid wheel locking. Many of the systems already provide in modern vehicles, measurement of angular velocity by a digital pulsed signal generator which generates 48 or 96 pulses per revolution of each wheel.

Further aspects of the present invention will become apparent from the following description, by way of example only, of one embodiment in conjunction with the attached diagrammatic drawings in which:

Fig.1. is a schematic diagrammatic diagram showing a deflation warning device for a car having four wheels.

The apparatus shown in Fig.1. provides a deflation warning device for a car having four wheels, 1,2,3 & 4 the wheels 1 and 2 being the front wheels and wheels 3 and 4 the rear wheels of the car. Each wheel 1, 2, 3 and 4 has a toothed wheel device associated with it of the type designed and fitted to provide a digital signal following a lateral magnetic pickup suitable for a vehicle anti-skid system of the electronic type - often commonly known as the electronic ABS. Each pickup is however, additionally connected in this case to a deflation warning detection system which system uses the same digital signal as the ABS system.

The four signals are carried through cables 5 to four separate inputs 6, 7, 8 and 9 of a central processing unit 10. Four separate indicator lights 12, 13, 14 & 15 are provided one for each wheel 1, 2, 3 & 4. These lights are most conveniently mounted on the vehicle dash-board perhaps in a line diagram of the vehicle.

The central processing unit is basically a computer which monitors the various signals and compares them to determine whether or not it should give an outward signal to indicate that a tyre of the vehicle is deflated.

Assuming that the respective frequencies of the signals from the front wheels 1 and 2 are F1 and F2 and the frequencies from the rear wheels 3 & 4, are F3 & F4 respectively and that these signals are all digital pulse signals it can be seen that the unit may compute these digital signals and by following the principles of calculation to be described below calculates whether or not to send a deflation warning signal to one of the warning lights 12, 13, 14 or 15. It should be noted that under normal conditions of full tyre inflation and straight running the four frequency signals will be substantially the same, and that under cornering of the vehicle F2 = F4 and F1 = F3. Similarly under acceleration in a straight line F1 = F2 and F3 = F4.

By way of example a Ford Granada vehicle having pulse generating units at each of its four wheels was utilised. The wheel generators have 96 teeth and so produce 96 pulses per revolution of each wheel. The vehicle was run at a speed of 100 km per hour on a fairly straight road, first with the tyres inflated at 2.0 bar in each of the four tyres, and secondly with three tyres inflated to 2.4 bar and the rear right tyre inflated to 1.8 bar.

The counts for time intervals of 6 seconds were totalled for each of the wheels and then a error signal dF was calculated using the formula,

$$dF = \frac{2 \times (F14 - F23) \times 100}{(F14 + F23)}$$

where $F14 = F1 + F4$ and $F23 = F2 + F3$

The results in the table have been chosen to show the different counts arising from different situations on the vehicle as follows:

SPEED INFLATION PRESSURE	F1	F2	F3	F4	Fav	G lat	G for	d F%	d F% RUNNING MEAN 3
120 Km/h									
2.0 bar	10002	10002	10002	10002	10002	-	-	0.000%	
2.0 bar a	10001	10003	10003	10001	10002	-	-	-0.020%	0.000%
2.0 bar	10003	10001	10001	10003	10002	-	-	+0.020%	
2.0 bar b	9502	9500	9500	9502	9501	-	<-0.03	-	
2.0 bar c	10504	10502	10502	10504	10503	-	>+0.03	-	
2.0 bar d	9754	11252	9752	11254	10503	>0.03	-	-	
1.8 bar rear right tyre, 2.4 bar others									
1.8 bar	10002	10002	10002	10025	10008	-	-	0.115%	
1.8 bar e	10001	10003	10003	10024	10008	-	-	0.095%	0.115%
1.8 bar	10003	10001	10001	10026	10008	-	-	0.135%	
50 Km/h									
2.0 bar	5003	5001	5001	5020	5006	-	<-0.03	-	
2.0 bar f	5001	5003	5003	5010	5005	-		0.130	
2.0 bar - cornering									
120 Km/h									
2.0 bar	10252	9752	10252	9752	10008	<0.03	-	0.000%	
2.0 bar g	10251	9753	10253	9751	10008	<0.03	-	-0.020%	0.000%
2.0 bar	10253	9751	10251	9753	10008	<0.03	-	+0.020%	
1.8 bar - cornering rear right tyre, 2.4 bar others									
1.8 bar	10252	9752	10252	9775	10008	<0.03	-	0.115%	
1.8 bar h	10251	9753	10253	9774	10008	<0.03	-	0.095%	0.115%
1.8 bar	10253	9751	10251	9776	10008	<0.03	-	0.135%	

a. The first three results show successive six second periods counts for the vehicle with all four wheels inflated to 2.0 bar whilst running straight. As can been seen dF is in a very small range over the three periods and a running mean of 0 was obtained.

b. The fourth result shows the condition when the vehicle is decelerated at more than 0.03 g, when the unit calculates from the successive counts that g has exceeded the preset value of.03 g and inhibits the calculation of dF so that in effect the unit is switched off.

c. The next result is for the condition where the vehicle is accelerating at more than 0.03 g when again the unit inhibits the calculation of dF.

d. The next result shows the condition where the lateral acceleration of the vehicle is greater than 0.03 g as calculated from the wheel speeds and the unit is again switched off.

The next block of results show similar tests with the right hand rear wheel of the vehicle deflated to 1.8 bar and the other three tyres set at 2.4 bar. The first three results e) are equivalent to the first three in the upper part of the table and show dF figures of 0.115%, 0.095% and 0.135% which exceed the necessary value for a pressure loss signal to be given and show a running mean dF of 0.115%. It should be noted that the lateral and forward accelerations were calculated to be zero because the vehicle was running straight and so the system proceeds to calculate dF and also looks at the difference between each wheel and the signals for each of the other wheels where it can be seen the difference is more than 1% and thus gives a pressure loss signal output.

The next two results f show for comparative purposes results for the same vehicle set up with the right rear wheel deflated at 50 km per hour to show that even with a lower count speed the unit is still able to calculate the acceleration laterally and in the forward direction and in the first case where it finds that the vehicle is decelerating at more than 0.03 g it inhibits the operation of the unit but in the second result where it finds no lateral or forward acceleration exceeding the value of 0.03 g it calculates the dF value and obtains a result of 0.13% which means that it gives a pressure loss signal having also checked the difference.

The next section of results g shows a vehicle at 120 km per hour with 2.0 bar in all of the tyres but under a cornering condition and the three successive periods of six seconds shown all have a calculated lateral acceleration of less than 0.03 g and therefore dF is calculated but because all four wheels are fully inflated the dF values are very small.

Finally the last part h of the chart of the table shows a cornering test again at 120 km per hour with the right-hand rear vehicle tyre deflated to 1.8 bar and the other three tyres set at 2.4 bar. In the three successive periods of six seconds shown lateral acceleration is calculated to be less than 0.03 g, and therefore the calculation of dF proceeds and it can be seen that figures of 0.115%, 0.095% and 0.135% are obtained which cause the pressure loss signal to be generated the system having checked that the count figure for F4 is more than 0.1% different to the average of the wheels as can be seen from the count figures.

The actual calculation of the lateral and longitudinal accelerations is carried out by the calculation of the wheel angular velocity signals for each side of the vehicle, comparing them and then comparing the signals from the front and rear pairs of wheels and the forward speed calculated from the mean of the angular velocities so that the unit is able to calculate accelerations without additional signal inputs.

As an alternative to calculating the acceleration and deceleration of the vehicle in its forward direction it is possible to connect a brake signal to the unit to inhibit it when the brake is touched. This may be done by connection to the stop light switch but it is preferred to sense vehicle acceleration by means of calculation from the wheel speeds themselves. For the lateral accelerations an accelerometer may be utilised in a similar way.

In the above examples the means of assessing the angular velocity of each wheel has been to count for a period of six seconds using a toothed wheel with 96 teeth and then to simply total the count in the periods. This is directly proportional to the angular velocity of the wheel in that period. The period of six seconds is by no means critical but it has been found to be a reasonable period to give a fairly quick response and yet to give sufficient counts for straightforward computer systems to be able to calculate and sense the small wheel speed change which result from a pressure loss of only part of a bar. Alternative count times may be used and indeed another useful way of avoiding spurious pressure loss signals is to compare successive periods of for example six seconds and only to give a signal if two successive periods have a warning signal calculated. This improves the ability to ignore wheel hop and other short term conditions such as wheel spin.

To fully allow for tyre and vehicle characteristics it is preferred to trigger, manually or otherwise a calibration indicating signal. This is done above 20 km per hour in substantially straight running.

As an alternative to counting i.e. using a digital signal to measure the angular velocity in each wheel, a timing system can be used where the time for a given number of counts, for example 100, can be taken and then used to compute the various wheel speeds from the time. This leads to the obvious conclusion that as an alternative to timing 100 pulses for example, the timing from one pulse to another could be used which allows the possibility of using the system with a wheel speed detector which gives a single pulse per revolution of the wheel. Thus the time period from pulse to pulse is the time for a single rotation of the wheel and this gives the advantage that a very simple wheel speed detector can be utilised.

In both systems the methods of calculation are the same once a value has been obtained for the angular velocity of each wheel.

In vehicles which travel at high speed there is also a speed effect on the tyre in that the loss in rolling radius on pressure loss becomes less at high speeds due to tyre characteristics and in some cases lifting of the vehicle from aerodynamic forces. This can be allowed for by the system increasing the sensitivity of detection by changing the critical dF values for initiating a pressure loss signal at high speeds of the vehicle. This can be done by sensing the vehicle speed from the angular velocity measured and using that speed to increase the sensitivity of the system.

In each case of lateral acceleration, longitudinal acceleration, vehicle speed, and vehicle loading, which can also be allowed for, the characteristics of the vehicle and the tyres themselves are important and vary from tyre to tyre and vehicle to vehicle. Thus the constants which are used in the resultant algorithm of all the above sensing conditions vary according to each vehicle. Nevertheless, it has been shown that these can be selected for each vehicle to give pressure loss sensing for a wheel of a vehicle of 0.6 bar or better. The actual means of computation in a vehicle is not a part of this invention and simply involves normal computer techniques with programmes chosen according to the language and operating system of the computer to be used. In that case the computer can be a part of the ABS computer for the vehicle.

Claims

1. A method of detecting a partially deflated pneumatic tyre on a vehicle having four tyres each mounted on a wheel by sensing the angular velocity of each wheel and producing a signal proportional thereto and processing the four signals in a processor unit which subtracts the sum of the signals from one pair of diagonally opposite wheels from the sum of the signals from the other pair of diagonally opposite wheels, sensing when the magnitude of the result is between 0.05% and 0.60% of the mean of the two sums of the signals from the two pairs of diagonally opposite wheels,
the method further comprises the steps of comparing the signals for each of the four wheels in turn with the signals for each of the other wheels, sensing when one of said signals is different to the average of all four signals by more than 0.1% and in the event of both sensed signal factors being present operating a warning device to indicate a tyre is partially or completely deflated.

2. A method according to claim 1 characterised in that the magnitude of the result is sensed in the range of 0.10% and 0.30%.

3. A method according to claim 1 or 2 characterised by the processing unit repeating the two sensing operations and operating the warning device when at least two successive results each give an indication of a tyre subject to pressure loss.

4. A method according to any one of claims 1 to 3 characterised by the processing unit also monitoring a lateral acceleration signal for the vehicle and inhibiting the warning signal for vehicle lateral accelerations greater than 0.03 g averaged over a period of 6 seconds or more.

5. A method according to claim 4 characterised by the processing unit itself calculating the lateral acceleration by comparison of the wheel angular velocity signals from side to side of the vehicle at both the front and rear pairs of wheels and the vehicle forward speed calculated from the mean of the angular velocities.

6. A method according to any of claims 1 to 5 characterised by the processing unit calculating the acceleration and deceleration of the vehicle in its direction of travel by monitoring the rate of change of the sum of the angular velocity of all four wheels with relation to time and inhibiting the pressure loss warning signal if the vehicle acceleration or deceleration exceeds 0.03 g averaged over a period of six seconds or more.

7. A method according to any one of claims 1 to 6 characterised by the processing unit monitoring the vehicle speed and for high vehicle speeds further decreasing the result and the wheel speed difference signals for a pressure loss warning signal to be given.

8. A method according to any one of claims 1 to 7 characterised by the processing unit operation being inhibited when the vehicle has its brakes applied.

9. A method according to any one of claims 1 to 8 characterised by the processing unit measuring the angular velocities of all four wheels at a calibration speed above 20 km per hour and on receiving a calibration request signal correcting for initial differences in rolling radius.

10. A method according to any one of claims 1 to 8 characterised by the angular velocity of the wheels being measured by a digital pulse generator associated with each wheel.

11. A method according to any one of claims 1 to 8 characterised by the angular velocity of the wheels being measured by a signal generated from the time of rotation of each wheel.

Patentansprüche

1. Verfahren zum Erfassen eines teilweise luftleeren Reifens an einem Fahrzeug mit vier Reifen, die jeweils an einem Rad angebracht sind, indem die Winkelgeschwindigkeit jedes Rads erfaßt und ein dazu proportionales Signal erzeugt wird, und die vier Signale in einer Prozessoreinheit bearbeitet werden, welche die Summe der Signale von einem Paar diagonal einander gegenüberliegender Räder von der Summe der Signale von dem anderen Paar diagonal einander gegenüberliegender Räder abzieht, erfaßt wird, wenn die Größe des Ergebnisses zwischen 0,05 % und 0,60 % des Mittelwerts der beiden Summen der Signale von den beiden Paaren diagonal einander gegenüberliegender Räder liegt, wobei das Verfahren ferner die Schritte umfaßt, daß die Signale für jedes der vier Räder der Reihe nach mit den Signalen für jedes der anderen Räder verglichen werden, wahrgenommen wird, wenn eines der Signale von dem Durchschnitt aller vier Signale um mehr als 0,1 % abweicht, und, falls beide erfaßten Signalfaktoren vorhanden sind, ein Warngerät betätigt wird, um anzuzeigen, daß ein Reifen teilweise oder vollständig luftleer geworden ist.

2. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß die Größe des Resultats im Bereich von 0,10% und 0,30% erfaßt wird.

3. Verfahren nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß die Bearbeitungseinheit die beiden Erfassungsvorgänge wiederholt und das Warngerät betätigt, wenn mindestens zwei aufeinanderfolgende Resultate jeweils einen Hinweis auf einen einem Druckverlust unterworfenen Reifen ergeben.

4. Verfahren nach einem der Ansprüche 1 bis 3, dadurch gekennzeichnet, daß die Bearbeitungseinheit auch ein Querbeschleunigungssignal für das Fahrzeug überwacht und das Warnsignal bei Fahrzeug-Querbeschleunigungen von mehr als 0,03 g, gemittelt während eines Zeitraums von 6 s oder mehr, sperrt.

5. Verfahren nach Anspruch 4, dadurch gekennzeichnet, daß die Bearbeitungseinheit selbst die Querbeschleunigung errechnet durch Vergleich der Rad-Winkelgeschwindigkeitssignale der Seiten des Fahrzeugs miteinander sowohl bei dem vorderen wie bei dem hinteren Radpaar und der Fahrzeug-Vorwärtsgeschwindigkeit, errechnet aus dem Mittelwert der Winkelgeschwindigkeiten.

6. Verfahren nach einem der Ansprüche 1 bis 5, dadurch gekennzeichnet, daß die Bearbeitungseinheit die Beschleunigung und Abbremsung des Fahrzeugs in seiner Fahrtrichtung errechnet durch Überwachen der Änderungsrate der Summe der Winkelgeschwindigkeiten aller vier Räder bezüglich der Zeit und Sperren des Druckverlust-Warnsignals, wenn die Fahrzeugbeschleunigung oder -abbremsung 0,03g überschreitet, gemittelt über einen Zeitraum von 6 s oder mehr.

7. Verfahren nach einem der Ansprüche 1 bis 6, dadurch gekennzeichnet, daß die Bearbeitungseinheit die Fahrzeuggeschwindigkeit überwacht und bei hohen Fahrzeuggeschwindigkeiten weiter die Resultat- und Radgeschwindigkeits-Differenzsignale vermindert, bei denen ein Druckverlust-Warnsignal zu geben ist.

8. Verfahren nach einem der Ansprüche 1 bis 7, dadurch gekennzeichnet, daß der Betrieb der Bearbeitungseinheit gesperrt wird, wenn die Fahrzeugbremsen angelegt sind.

9. Verfahren nach einem der Ansprüche 1 bis 8, dadurch gekennzeichnet, daß die Bearbeitungseinheit die Winkelgeschwindigkeiten aller vier Räder bei einer Eichgeschwindigkeit über 20 km/h mißt und bei

Empfang eines Eich-Anforderungssignals Anfangsdifferenzen des Rollradius ausgleicht.

10. Verfahren nach einem der Ansprüche 1 bis 8, dadurch gekennzeichnet, daß die Winkelgeschwindigkeit der Räder durch jeweils einen jedem Rad zugeordneten Digitalimpuls-Generator gemessen wird.

11. Verfahren nach einem der Ansprüche 1 bis 8, dadurch gekennzeichnet, daß die Winkelgeschwindigkeit der Räder gemessen wird durch ein Signal, das von der Umdrehungszeit jedes Rades erzeugt wird.

Revendications

1. Procédé de détection de la présence d'un pneumatique partiellement dégonflé, sur un véhicule ayant quatre pneumatiques montés chacun sur une roue, par détection de la vitesse angulaire de chaque roue et formation d'un signal qui lui est proportionnel, et par traitement des quatre signaux dans un ensemble de traitement qui soustrait la somme des signaux d'une paire de roues opposées en diagonale de la somme des signaux de l'autre paire de roues opposées en diagonale, par détection du moment où l'amplitude du résultat est comprise entre 0,05 % et 60 % de la moyenne des deux sommes des signaux des deux paires de roues opposées en diagonale, le procédé comprenant en outre les étapes suivantes : la comparaison des signaux de chacune des quatre roues tour à tour aux signaux de chacune des autres roues, la détection du moment où l'un des signaux est différent de la moyenne des quatre signaux de plus de 0,1 % et, dans le cas où les deux facteurs des signaux détectés sont présents, la commande d'un dispositif avertisseur destiné à indiquer qu'un pneumatique est partiellement ou totalement dégonflé.

2. Procédé selon la revendication 1, caractérisé en ce que l'amplitude du résultat est détectée dans la plage comprise entre 0,10 et 0,30 %.

3. Procédé selon la revendication 1 ou 2, caractérisé en ce que l'unité de traitement répète les deux opérations de traitement et commande le dispositif d'avertissement lorsque deux résultats successifs au moins donnent chacun une indication du fait qu'un pneumatique présente une perte de pression.

4. Procédé selon l'une quelconque des revendications 1 à 3, caractérisé en ce que l'unité de traitement contrôle aussi un signal d'accélération latérale du véhicule et inhibe la création du signal d'avertissement lorsque l'accélération latérale moyenne du véhicule dépasse 0,03 g sur une période d'au moins 6 s.

5. Procédé selon la revendication 4, caractérisé en ce que l'unité de traitement elle-même calcule l'accélération latérale par comparaison des signaux de vitesse angulaire des roues entre les deux côtés du véhicule, à la fois au niveau des paires avant et arrière de roues, et de la vitesse d'avance du véhicule, calculée d'après la moyenne des vitesses angulaires.

6. Procédé selon l'une quelconque des revendications 1 à 5, caractérisé en ce que l'unité de traitement calcule l'accélération et la décélération du véhicule dans sa direction de déplacement par contrôle de la vitesse de variation de la somme des vitesses angulaires des quatre roues au cours du temps et par inhibition de la création du signal d'avertissement de perte de pression lorsque l'accélération ou la décélération moyenne du véhicule dépasse 0,03 g, sur une période d'au moins 6 s.

7. Procédé selon l'une quelconque des revendications 1 à 6, caractérisé en ce que l'unité de traitement contrôle la vitesse du véhicule et, dans le cas de vitesses élevées du véhicule, réduit le résultat et les signaux de différence de vitesses de roues pour lesquels un signal d'avertissement de perte de pression est donné.

8. Procédé selon l'une quelconque des revendications 1 à 7, caractérisé en ce que le fonctionnement de l'unité de traitement est inhibé lorsque les freins du véhicule sont serrés.

9. Procédé selon l'une quelconque des revendications 1 à 8, caractérisé en ce que l'unité de traitement mesure les vitesses angulaires des quatre roues à une vitesse d'étalonnage supérieure à 20 km/h et lors de la réception d'un signal de demande d'étalonnage destiné à corriger les différences initiales de rayons de roulement.

10. Procédé selon l'une quelconque des revendications 1 à 8, caractérisé en ce que la vitesse angulaire des roues est mesurée par un générateur numérique d'impulsions associé à chaque roue.

11. Procédé selon l'une quelconque des revendications 1 à 8, caractérisé en ce que la vitesse angulaire des roues est mesurée à l'aide d'un signal créé à partir de la durée d'une rotation de chaque roue.

Fig.1